not kill the active agent. He now sought to purify this agent and turned that task[1] over to a new assistant, Albert Claude, who had received his M.D. at Liége in 1928 and spent a year in a tissue-culture laboratory in Berlin before Murphy recruited him in 1929.

Claude pursued a number of strategies in the attempt to purify the agent, including adsorption, precipitation, and dialysis. Precipitation of carbohydrate with gelatin followed by dialysis resulted in a twentyfold "enrichment of the tumor producing agent" (Claude, 1935). He identified a protein and a phospholipid as the principal constituents of the active residue. None of these techniques, however, produced the desired purification.

At this point Claude read the report of two British researchers, Ledingham and Gye (1935), who had tried using high-speed centrifugation to separate a tumor producing agent (also McIntosch, 1935, who employed a Henriot and Huguenard air-driven ultracentrifuge). Although the substance Ledingham and Gye isolated had less tumor producing capacity than the initial cell extract, Claude saw the promise of their approach and set out to refine it. In 1937 he first reported on using a high-speed centrifuge to isolate a more potent tumor causing agent (Claude, 1937)[2] and in 1938 he claimed even better results – a tumor-causing agent with ten to fifty times greater potency than the original extract (Claude, 1938b). In the 1938 *Annual Report* Claude began to characterize the chemical makeup of the active particle, arguing that it contained phospholipids as well as ribosenucleic acid. The chemical composition of the tumor-producing fraction was also the focus of a further paper (Claude, 1939). Viewing the fraction under a dark-field microscope, he observed it to consist of small granules approximately 70 mμ in diameter.

As a control to his work with tumor cells, Claude (1938a) centrifuged normal tissues, and discovered to his surprise a fraction with granules similar to that generated by centrifugation of tumor cells. Its chemical composition was also similar: "The chick embryo material, like the tumor fraction, is

[1] Murphy continued to work on tumors of fowl with Sturm and was the official head of the laboratory until his retirement in 1949. He focused on such topics as chemical induction of tumors (by dibenzanthracene, for example) and their transmissibility. He also examined the effect of such variables as season of year and genetic constitution on susceptibility to the cancers.

[2] In the 1937 *Annual Report*, Claude described introducing centrifugation to address the problem of why a related tumor, Chicken Tumor 10, could be transferred through filtrates. In 1931 Murphy and Claude had shown that alumina gel had to be added to produce an active filtrate with Rous sarcoma. They proposed that the alumina gel removed an inhibitor. Claude now argued that the problem with Chicken Tumor 10 was also due to an inhibitor by showing that the centrifuged particle when combined with water could generate the tumor. When the particle was combined with the supernatant from the centrifugation it could not do so, suggesting that the supernatant contained an inhibitor.